

# TMOS – Thermal MOS

TMOS technology  
Presence sensing



TMOS use cases



STHS34PF80



Technologies comparison





# Thermal MOSFET (TMOS)

TMOS measures the integration of infrared radiation of objects inside the field of view



**TMOS - Sensing element**  
CMOS + MEMS technology



**Human body**  
Radiation is about 9.8um, therefore it is in the center of ST IR bandwidth 5 to 20um

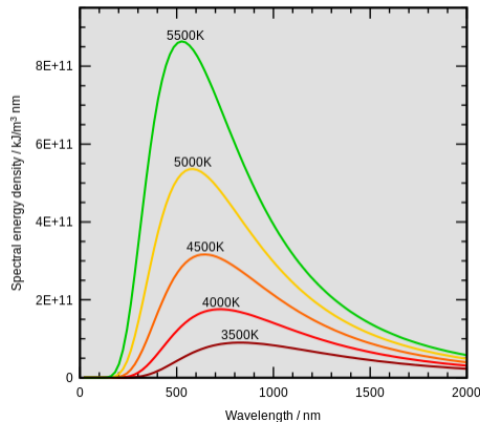


**Biometric**  
Presence detection and temperature measurement

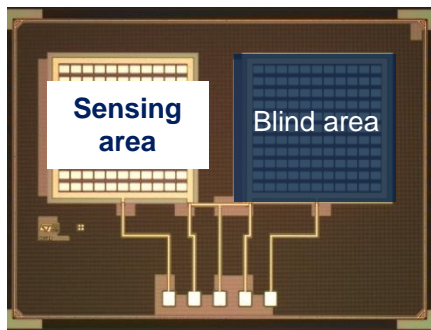


# TMOS Presence & Motion Sensor

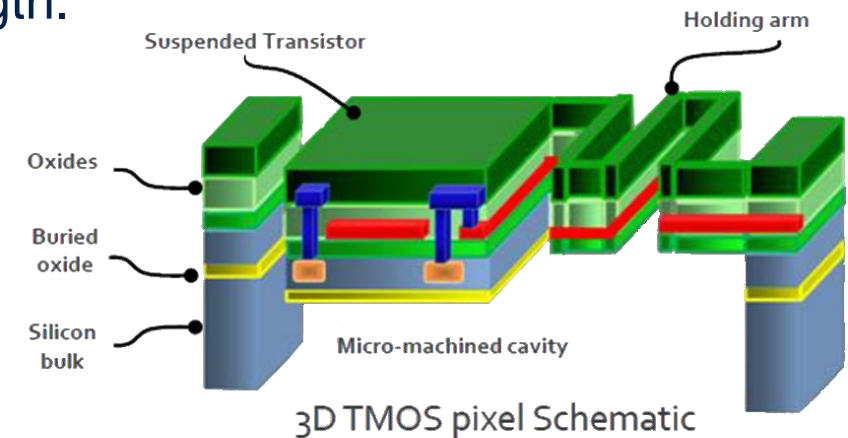
## What is the TMOS sensing technology



- **TMOS is Infrared sensor** , measures amount of Infrared Radiation emitted from objects.
  - Every object emits each different thermal radiation depending on its temperature.
  - Enables to detect **object presence / movement** and measure **body temperature**.
- **TMOS** is based on CMOS transistor which is thermally isolated to measure IR radiation ranged 5 to 20um IR wavelength.
- 1 sensing area + 1 blind area covered by cap metallization in sensing element
- **ST MEMS technology**
  - Sensing area is mechanically isolated to thermal.
  - Integrated absorber to improve sensitivity
  - High Vacuum in wafer level packing.



TMOS Sensing element





# Occupancy detection with TMOS Sensor

## Application use cases

### Presence/Movement detection

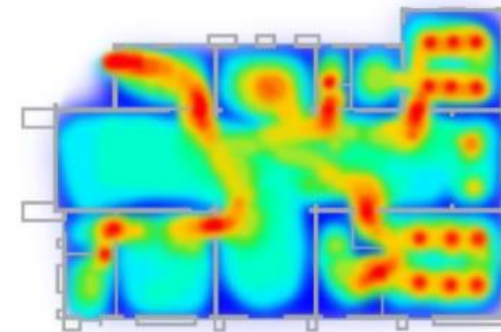
- Presence Detection
- Absence Detection
- To control Smart Lighting / HVAC / Automatic door & for security



### Occupancy detection

#### Context awareness (Single / Multi TMOS distributed)

- # of people counting.
- Object movement monitor
- Object direction / speed
- Indoor location monitoring





# TMOS – STHS34PF80

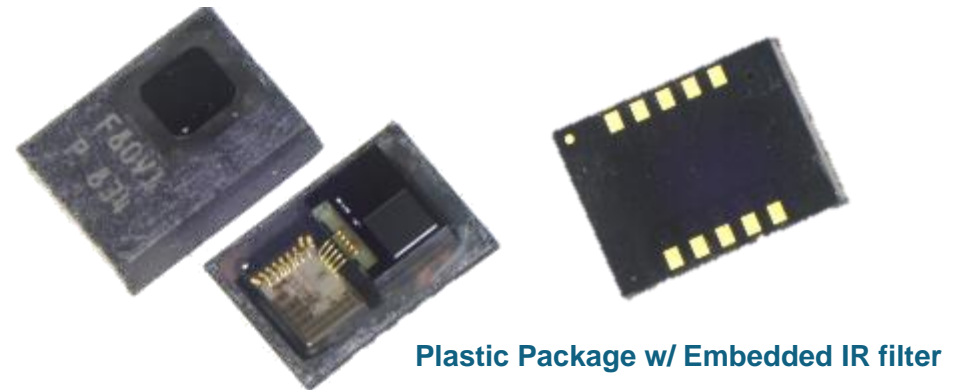
## Single pixel presence / Motion detector

IR based technology for occupancy (**presence / motion**) detection  
measuring integration of IR radiation changed by absolute temperature

- Supply voltage: 1.7 V to 3.6 V
- Object temperature sensitivity : 2000 LSB/°C
- Supply current <sup>(1)</sup>: 10 uA @ 1Hz
- Power down current : 1 uA
- Digital I<sup>2</sup>C / 3-wires SPI interface
- Presence / movement detection up to 4 meter
- Embedded Temperature sensor for ambient
  - Accuracy (Tamb) ±0.5°C typ @ -10 ~ 60°C
- Operating wavelength 5um to 20um
- 80deg Full Field of View (FOV)

Top / inner view

Bottom view



Plastic Package w/ Embedded IR filter

LGA-10L 3.2 x 4.2 x 1.455 mm

Note (1) : Average Setting TMOS=128 Temperature=1

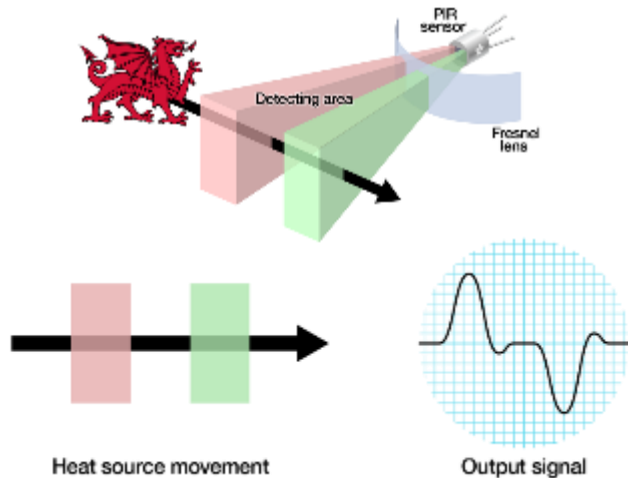




# Existing technology for occupancy detection

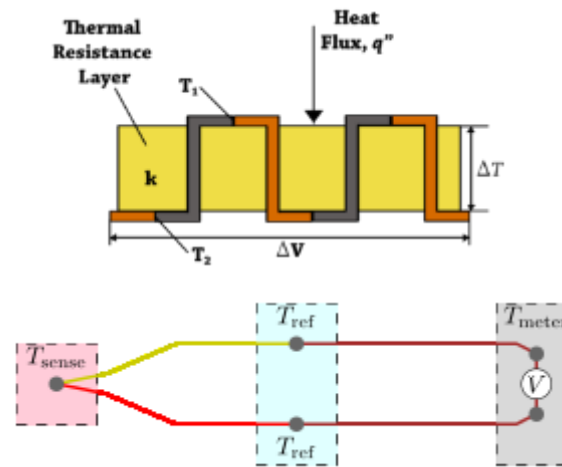
## PIR (PYRO)

- Working principle: Delta Temperature between  $T_{obj}$  and  $T_{chip}$  triggers change in output voltage
- Fresnel LENS for heat source movement
- For long distance (meter) detection
- Motion detection, Not capable of presence detection



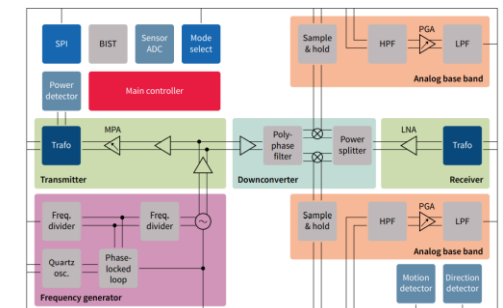
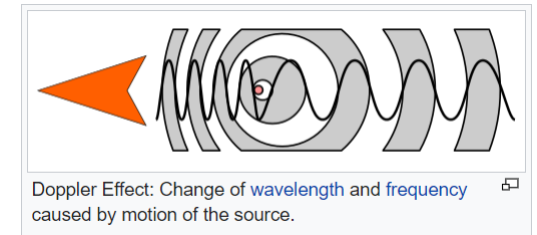
## Thermopile

- Working principle: Absolute temperature (temperature difference to two junctions)
- For short distance (cm) detection
- More used for temperature sensor.



## Radar (24 GHz / 60 GHz)

- Working principle : Doppler Principle for object's motion.
- For long distance (10meter ~100 meter)
- High Cost & RF design.





# TMOS technology comparison

TMOS solutions from ST aims to provide the best option in terms of performance, cost, size...

	TMOS	PIR	Thermopile	RADAR	Ultrasonic	Laser
Cost	●	●	●	●	●	●
PKG size	13mm <sup>2</sup>	>40mm <sup>2</sup>	>20mm <sup>2</sup>	>20mm <sup>2</sup>	>100mm <sup>2</sup>	●
Accuracy / Sensitivity	●	●	●	●	●	●
Power consumption	●	●	●	●	●	●
Distance range	4 meter (w/o LENS) Longer with LENS	Depends on Fresnel LENS	< 1meter	>10 meter	>10meter	>10meter
Application integration	●	●	●	●	●	●
Stationary / Movement detection	●	●	●	●	●	●
Resist to environmental condition	Sensitive to T <sub>amb</sub>	Sensitive to T <sub>amb</sub>	Sensitive to T <sub>amb</sub>	Sensitive to RF	Sensitive to noise	●

● weak   ● normal   ● good

